DATA SHEET

CISCO CATALYST 6500 SERIES 10/100 AND 10/100/1000 ETHERNET INTERFACE MODULES

As the premier Cisco® modular multilayer switch, the Cisco Catalyst® 6500 Series delivers secure, converged services from the wiring closet to the core, to the data center, and to the WAN edge.

The Cisco Catalyst 6500 Series provides the broadest selection of 10/100 and 10/100/1000 Ethernet media, Power over Ethernet (PoE) (inline power) options, densities, performance, interoperability, and chassis deployment options. From basic wiring closets and small campus distribution and core layers to high-performance data centers, the Cisco Catalyst 6500 Series 10/100BASE-TX modules scale from 16 ports up to 1152 ports, and the 10/100/1000BASE-TX modules scale from 16 ports up to ports in a single Cisco Catalyst 6500 Series chassis. Cisco Catalyst 6500 Series 10/100 and 10/100/1000 modules offer:

- *Proven and widely deployed Cisco AVVID (Architecture for Voice, Video and Integrated Data) wiring-closet solution*—These modules are the most widely deployed Cisco IP Telephony port-enabled campus switch.
- *Choice of media and connector types*—These modules are available in copper unshielded twisted-pair (UTP) and shielded twisted-pair (STP) using RJ-45 or RJ-21.

Note: Refer to the "Cisco Catalyst 6500 Series Mixed-Media Gigabit Ethernet Interface Modules" data sheet for information about modular physical layer deployment options using gigabit interface converters (GBICs) and Small Form-Factor Pluggable (SFP) form factors.

- *IEEE 802.3af PoE support (for example, IP phone and wireless access point)*—These modules support PoE field upgrade, network-interface-card (NIC) and phone auto detection (phone discovery), and voice VLANs.
- *Simplified network operation with cable fault detection*—These modules offer the ability to test cabling using a time domain reflectometer (TDR), which sends signals down the cable to identify faults in each twisted pair (available on some 10/100 and all 10/100/1000 Ethernet-over-copper interface modules).
- *Range of port densities*—These modules are available with 16 to 96 ports per module, enabling up to 1152 10/100BASE-TX ports or 576 10/100/1000BASE-TX ports per 13-slot chassis (configured with 12 interface modules).
- *Scalable and predictable system performance*—These modules provide a selection of switch-fabric connections and throughput options: 32-, 256-, and 720-Gbps bandwidth with a system throughput of: 15, 30, 210, and up to 400 Mpps.
- *IEEE 802.3 triple-speed autonegotiation*—These modules allow switches to negotiate speed (10, 100, and 1000 Mbps) and duplex mode (half or full) with attached devices.
- *Superior traffic management*—These modules are available with large (up to 1 MB per interface) buffers and up to 4 transmit queues to aid in congestion avoidance, traffic prioritization, and policing; multiple thresholds can be configured to manage differentiated levels of service.
- *Operational consistency*—These modules Configurations offer configurations for Cisco Catalyst 6500 Series 3-, 6-, 9-, and 13-slot chassis running Cisco IOS® Software and Cisco Catalyst Operating System Software; they are interoperable with all other interfaces and services modules and forward-compatible with all Cisco Catalyst 6500 Series supervisor engines.
- *Maximum network uptime and resiliency*—These modules support the Cisco Enhanced Per- VLAN Spanning Tree Plus (PVST+) protocol, IEEE 802.1w Rapid Spanning Tree Protocol (RSTP), IEEE 802.1s Multiple Spanning Tree (MST) protocol, Per-VLAN Rapid Spanning Tree (PVRST) protocol, Hot Standby Router Protocol (HSRP), Virtual Router Redundancy Protocol (VRRP), Cisco EtherChannel® technology, and IEEE 802.3ad link aggregation for fault-tolerant connectivity.
- *Extensive management tools*—These modules support the CiscoWorks network-management platform; Simple Network Management Protocol (SNMP) Versions 1, 2, and 3; and four Remote Monitoring (RMON) groups (statistics, history, alarms, and events).

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IP TELEPHONY AND USER-MOBILITY SUPPORT WITH CISCO CATALYST 6500 SERIES 10/100 AND 10/100/1000 ETHERNET INTERFACE MODULES

The Cisco Catalyst 6500 Series is a lead element in Cisco AVVID, providing numerous IP telephony and network security features for the enterprise.

The Cisco Catalyst 6500 Series delivered the industry's first Ethernet switching modules that provided PoE for converged data and voice traffic as well as other powered devices, such as wireless access points. Several Cisco Catalyst 6500 Series interface modules support PoE on each interface port, allowing customers to build campus multiservice data and voice networks for wiring closets with the following features:

- *PoE*—Provides power for Cisco Prestandard Inline Power and IEEE 802.3af standard PoE over standard Category 5 UTP cable up to 100 meters for such as IP phones and wireless access points
- *Powered Device Discovery*—Detects the presence of a powered device such as an IP phone and supplies inline power automatically
- *Auxiliary VLAN using 802.1Q*—Segments IP phones and data endpoints into separate, logical networks automatically
- *Automatic quality of service (AutoQoS)*—Simplifies the task of configuring QoS mechanisms for IP telephony and more
- *Cisco Identity Based Networking Services (IBNS)*—Enables greater security while simultaneously offering cost-effective management of changes throughout the organization

CISCO CATALYST PRESTANDARD INLINE POWER AND IEEE 802.3AF POE

Using existing Category 5 UTP installations, the PoE feature helps enable network administrators to control power distribution from a central location. Configuring Cisco Catalyst 6500 Series switches with uninterruptible-power-supply (UPS) systems helps ensure that building power outages will not affect network telephony connections, providing greater network availability.

Enabled by a daughter card for “pay-as-you-grow” flexibility, several Cisco Catalyst 6500 Series 10/100 and 10/100/1000 Ethernet interface modules support PoE. Some of these interface modules support the IEEE 802.3af standard as an additional upgrade option. The Cisco Catalyst PoE feature implementation passes the required domestic and international safety regulations and compliance measures.

All Cisco Catalyst 6500 Series 802.3af PoE modules support all three classes of powered devices, delivering a maximum of 15.4W per port as defined in the standard:

- Class 1—Up to 4W per port
- Class 2—Up to 7W per port
- Class 3—Up to 15.4W per port

All 802.3af PoE modules are capable of supporting up to 48 Class 3 devices per module (that is, 15.4W per port for 48 ports simultaneously). The maximum number of powered devices supported in a system for each class depends on the specific system configuration such as chassis type, supervisor engine, and power supply used. (Refer to Table 1.)

Table 1. Cisco Catalyst 6500 Series PoE Products

Product Number	Speed	IEEE 802.3af PoE Support	Cisco Prestandard PoE Support	Maximum Power per Port
WS-X6548-GE-45AF	10/100/1000	Yes	Yes	15.4W
WS-X6548V-GE-TX	10/100/1000	Field upgradeable with WS-F6K-GE48-AF= daughter card	Yes	7W; 15.4W with WS-F6K-GE48-AF= daughter card upgrade
WS-X6148A-GE-45AF	10/100/1000	Yes	Yes	15.4W
WS-X6148-GE-45AF	10/100/1000	Yes	Yes	15.4W

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Product Number	Speed	IEEE 802.3af PoE Support	Cisco Prestandard PoE Support	Maximum Power per Port
WS-X6148V-GE-TX	10/100/1000	Field upgradeable with WS-F6K-GE48-AF= daughter card	Yes	7W; 15.4W with WS-F6K-GE48-AF= daughter card upgrade
WS-X6348-RJ45V	10/100	No	Yes	7W
WS-X6348-RJ21V	10/100	No	Yes	7W
WS-X6196-21AF	10/100	Yes	Yes	15.4W
WS-X6148X2-45AF	10/100	Yes	Yes	15.4W
WS-X6148A-45AF	10/100	Yes	Yes	15.4W
WS-X6148-45AF	10/100	Yes	Yes	15.4W
WS-X6148-RJ45V	10/100	Yes (part number WS-X6148-45AF-UG=) for upgrade	Yes	7W
WS-X6148-21AF	10/100	Yes	Yes	15.4W
WS-X6148-RJ21V	10/100	Yes; Use (part number WS-X6148-21AF-UG=) for upgrade	Yes	7W

POWERED DEVICE DISCOVERY

The Powered Device Discovery feature eases network-management burdens by automating the PoE feature. With Powered Device Discovery, the Cisco Catalyst switch detects the presence of a powered device and supplies inline power automatically, eliminating the need to manually enable ports for inline power. The Powered Device Discovery mechanism is intelligent enough to differentiate between an IP phone and a NIC, and does not supply inline power to NICs or other devices not designed to use inline power. With this feature, network administrators can depend on automatic and centralized control of inline power that is safe to deploy and maintain.

In addition to the standard Powered Device Discovery feature, the Cisco Catalyst 6500 Series PoE module also provides intelligent power management such that it negotiates power requirements with Cisco powered devices using Cisco Discovery Protocol so that the switch supplies only the required amount of power instead of the maximum possible for a specific device class, thereby optimizing the overall power consumption in the system.

AUXILIARY VLAN

The unique Auxiliary VLAN feature offered by Cisco Systems® provides automatic VLAN configuration for IP phones. It places phones into their own VLANs automatically, simplifying the task of overlaying a voice topology onto a data network. It allows network administrators to easily segment phones into separate, logical networks, even though the data and voice infrastructure is physically the same—greatly simplifying the tasks of managing a multiservice network and identifying and troubleshooting network problems.

The Auxiliary VLAN feature maintains VLAN assignments, even when phones are moved to new locations. When a user plugs a phone into the switch, the switch provides the phone with the necessary VLAN information.

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AutoQoS

Network administrators can assign IP phones to separate IP subnets and VLANs to allow separate QoS or security policies for IP phones. The administrative task of configuring QoS to establish end-to-end traffic prioritization is greatly simplified by deploying AutoQoS, which configures QoS on voice ports automatically.

CISCO IBNS

Cisco IBNS builds on and enhances the capabilities of industry-standard IEEE 802.1X 10 by providing increased security and greater flexibility for enterprise wired or wireless network access. Policies are associated with users, not physical ports. This provides users with greater mobility and freedom, allowing security and service-level policies to travel with them throughout the enterprise. As a result, network scalability is increased while simplifying network management through centralized policy enforcement and dynamic provisioning. Centralized policy-based administration decreases the time, complexity, and effort associated with port security techniques at the MAC level. Cisco IBNS can help to quickly provision support for cross-functional or new project teams, enable secure access for trusted partners and vendors, and facilitate secure conference-room connectivity. For more information, refer to:

http://www.cisco.com/en/US/partner/netsol/ns110/ns170/ns171/ns75/networking_solutions_package.html

ENHANCED OPERATIONAL CONTROL FOR ENHANCED MANAGEABILITY

The Cisco Catalyst 6500 Series offers advanced network-management features to make it easy to manage fast-growing networks. This includes TDR supported on the new 48-port 10- and 100-Mbps and all the 48-port 10-, 100-, and 1000-Mbps Ethernet modules (part numbers WS-X6148A-RJ-45, WS-X6148A-45AF, WS-X6148A-GE-TX, WS-X6148A-GE-45AF, WS-X6148-GE-TX, WS-X6548-GE-TX, and WS-X6748-GE-TX, respectively). TDR tests cabling by sending a signal down the cable, reporting cable breaks, cable crimps, and improperly wired cable.

All Ethernet modules support extensive interface-level statistics, including four RMON groups: alarms, events, history, and statistics. Additional RMON groups (all nine groups) can be monitored using the integrated Cisco Catalyst 6500 Series Network analysis Module (NAM) or switch probes.

For in-depth network analysis, the Switched Port Analyzer (SPAN) feature helps network managers redirect traffic from each switched port to a specific VLAN, allowing them to add, move, and easily change group access to network resources from centralized locations using CiscoWorks network-management software.

Support for local, out-of-band management is delivered through a terminal or modem attached to the console or auxiliary interface of the supervisor engine. Remote in-band management is available with SNMP Versions 1, 2, and 3.

CISCO CATALYST 6500 SERIES 10/100 AND 10/100/1000 MODULES

Cisco Catalyst 6500 Series 10/100 and 10/100/1000 Ethernet interface modules feature three classes of forwarding architectures and switch-fabric interconnections—classic, Cisco Express Forwarding 256, and Cisco Express Forwarding 720—to provide a choice of speeds and forwarding rates. Table 2 highlights the primary differences in the three classes of forwarding and switch-fabric architectures.

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Table 2. Classic, Cisco Express Forwarding 256, and Cisco Express Forwarding 720 10/100 and 10/100/1000 Interface Module Comparison

Feature	Classic Interface Modules	Cisco Express Forwarding 256 Interface Modules	Cisco Express Forwarding 720 Interface Modules
Performance or Forwarding Rate (Mpps)	• 32 Gbps; 15 Mpps per system	• 256 Gbps using Cisco Express Forwarding; up to 30 Mpps per system • Using Distributed Cisco Express Forwarding upgrade: Up to 15 Mpps per slot for slots equipped with distributed forwarding card (DFC) or DFC3 to support distributed forwarding	• 720 Gbps using Cisco Express Forwarding; up to 30 Mpps per system • Using Distributed Cisco Express Forwarding upgrade, up to 48 Mpps sustained per slot for modules equipped with DFC3 to support distributed forwarding
Forwarding-Engine Architecture	• Centralized Cisco Express Forwarding engine located on supervisor policy feature card (PFC) makes forwarding decision	• Centralized Cisco Express Forwarding engine located on supervisor PFC makes forwarding decision • Upgradable to Distributed Cisco Express Forwarding switching* with optional WS-F6K-DFC or WS-F6K-DFC3)	• Centralized Cisco Express Forwarding engine located on supervisor PFC makes forwarding decision • Upgradable to Distributed Cisco Express Forwarding local switching with optional WS-F6700-DFC3)
Supervisor Engine Supported	• Supervisor Engine 1A • Supervisor Engine 2 • Supervisor Engine 720	• Supervisor Engine 1A • Supervisor Engine 2 • Supervisor Engine 720	• Supervisor Engine 720
Optional DFC Upgrade Support	• Not supported	• Use WS-F6K-DFC) with Supervisor Engine 2 and switch fabric module 2 (SFM2) • Use WS-F6K-DFC3) with Supervisor Engine 720	• Use WS-F6700-DFC3) with Supervisor Engine 720
Fabric Connections	• Connection to 32-Gbps shared bus (all supervisors)	• Connections through single 8-Gbps channel to switch fabric (Supervisor Engine 720 or Supervisor Engine 2 with SFM) and 32-Gbps shared bus	• Dual 20-Gbps (40 Gbps total) channel connection to switch fabric on Supervisor Engine 720
Chassis or Slot Support Requirements	• Any slot in any chassis	• Any slot in any chassis	• Any slot in Cisco Catalyst 6506, Catalyst 6509, Catalyst 6509-NEB-A, and slots 9 through 13 on Cisco Catalyst 6513; Cisco Catalyst 6503 not supported at current time

* The WS-X6548-GE-TX, WS-X6548V-GE-TX, and WS-X6548-GE-45AF modules do not support distributed forwarding; a WS-F6K-DFC and WS-F6K-DFC3A/B/BXL) cannot be installed on these interface modules.

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CISCO CATALYST 6500 SERIES CISCO EXPRESS FORWARDING 720 10-, 100-, AND 1000-MBPS ETHERNET-OVER-COPPER MODULES

Designed for high-performance enterprise and service provider distribution, core layers, data-center, and Web-hosting applications where voice capability is not required, Cisco Express Forwarding 720 twisted-pair interface modules provide line-rate 10/100/1000 Ethernet forwarding with the following operational advantages (refer to Table 3):

- *Forwarding architecture*—These modules use the central Cisco Express Forwarding engine located on the supervisor engine; optional field-upgradable Distributed Cisco Express Forwarding daughter cards are available.
- *Forwarding performance*—These modules forward packets up to 30 Mpps per system; they forward packets up to sustained 48 Mpps per slot for slots equipped with distributed forwarding cards (DFC or DFC3).
- *Fabric connection*—These modules connect to the switch-fabric channels using dual 20 Gbps switch-fabric channels (40 Gbps total).
- *Supervisor engine*—These modules work with Supervisor Engine 720.
- *Distributed forwarding upgrade option*—These modules help enable full locally distributed forwarding; they use an optional (part number WS-F6700-DFC3) upgrade to operate with the Supervisor Engine 720, and they provide optimal interface module performance.
- *Slot and chassis requirements*—These modules can occupy any slot in the Cisco Catalyst 6506, Catalyst 6509, Catalyst 6509-NEB, or Catalyst 6509-NEB-A; they require slots 9 through 13 when used in the Cisco Catalyst 6513. Cisco Catalyst 6503 support is under consideration for the future (refer to release notes for details).
- *Maximum port density per chassis*—These modules support up to 384 ports per Cisco Catalyst 6509, up to 240 Cisco Express Forwarding-based ports, and an additional 336 classic or Cisco Express Forwarding 256-based ports per Cisco Catalyst 6513.

Note: PoE is not supported on Cisco Express Forwarding 720 10/100/1000 interface modules.

Table 3. Cisco Express Forwarding 720 Copper 10/100/1000 Ethernet Interface Module

Product Number	Primary Application	Ports, Connector, Maximum Distance, and Cable Type	PoE Support	Maximum Frame Size (jumbo frame) Support	Queues per Port (Tx = Transmit, Rx = Receive)*	Buffer Size per Port
WS-X6748-GE-TX	Data center and server farm	48, RJ-45, 100m, Category 5 cable	No	Up to 9216 bytes per frame	Tx-1p3q8t; Rx-1q8t (when using Distributed Cisco Express Forwarding)	1.3 MB

* Queues Legend: 1p3q1t = 1 priority queue, 3 round robin queues, 1 threshold

Figure 1. Cisco Express Forwarding 720 10/100/1000 Interface Module (part number WS-X6748-GE-TX) with Distributed Cisco Express Forwarding Daughter Card (part number WS-F6700-DFC3A)

CISCO CATALYST 6500 SERIES CISCO EXPRESS FORWARDING 256 10/100 AND 10/100/1000 INTERFACE MODULES

Designed for premier wiring closets, small campus backbone, and server farm applications, Cisco Express Forwarding 256 10/100 and 10/100/1000 Ethernet-over-copper interface modules provide line-rate 10/100 Ethernet forwarding and gigabit bandwidth options. (Refer to Table 4).

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The PoE Cisco Express Forwarding 256 10/100/1000 interface modules provide flexible 10-, 100-, and 1000-Mbps access to the desktop through standard RJ-45 connectors. These interface modules feature PoE field-installable daughter cards for pay-as-you-grow investment protection and flexibility. Purposefully designed for the wiring closet with 8:1 oversubscription, these 10/100/1000 interface modules cannot be equipped with distributed forwarding cards.

Offered with a choice of RJ-45 and RJ-21 connectors, the data-only Cisco Express Forwarding 256 10/100 and 16-port 10/100/1000 Ethernet interface modules can be deployed where PoE capability is not required, and they can be equipped with distributed forwarding daughter cards for higher-performance local packet-forwarding environments.

The Cisco Catalyst 6500 Series Cisco Express Forwarding 256 10/100 and 10/100/1000 interface modules offer the following operational advantages and characteristics:

- *Forwarding architecture*—These modules use the central Cisco Express Forwarding engine located on the supervisor engine.
- *Forwarding performance*—These modules forward packets up to 30 Mpps per system and up to 15 Mpps per slot if upgraded to support distributed forwarding.
- *Fabric connection*—These modules connect to the switch fabric through one 8-Gbps connection and the 32-Gbps shared bus.
- *Supervisor engine*—These modules work with Supervisor Engine 1A, Supervisor Engine 2, or Supervisor Engine 720.
- *Slot requirements*—These modules can occupy any slot in any Cisco Catalyst 6500 Series chassis.
- *Maximum port density per chassis (48-port modules)*—These modules support up to 576 ports per Cisco Catalyst 6513, and up to 384 ports per Cisco Catalyst 6509.
- *Maximum port density per chassis (16-port modules)*—These modules support up to 192 ports per Cisco Catalyst 6513, and up to 128 ports per Cisco Catalyst 6509.

Exclusive features of the Cisco Express Forwarding 256 10/100 and 16-port Cisco Express Forwarding 256 10/100/1000 Ethernet interface modules follow:

- *Distributed forwarding upgrade*—An optional upgrade is available to perform distributed forwarding; it requires a WS-F6K-DFC3 upgrade to operate with Supervisor Engine 720; a WS-F6K-DFC upgrade to operate with Supervisor Engine 2 Multilayer Switch Feature Card 2 (MSFC2); and an SFM.

Exclusive characteristics and features of the 48-port Cisco Express Forwarding 256 10/100/1000 Ethernet interface module follow:

- *Field-installable and -upgradable PoE daughter cards*—Sharing the same Category 5 UTP cabling used for network connections, these daughter cards help enable centralized power distribution to IP phones, wireless access points, and other powered devices.
- These modules are designed to support field upgrades to the IEEE 802.3af PoE standard with a new daughter card providing maximum investment protection.
- *TDR*—TDR tests cabling by sending signals down the cable to identify faults in each twisted pair.
- *Distributed forwarding upgrade*—This feature is not supported. The WS-X6548-GE-TX, WS-X6548V-GE-TX, and WS-X6548-GE-45AF do not support distributed forwarding (WS-F6KDFC and WS-F6K-DFC3A).

Table 4 shows application, port, and queue data for the Cisco Express Forwarding 256 10/100 and 10/100/1000 modules.

Table 4. Cisco Express Forwarding 256 10/100 and 10/100/1000 Modules

Product Number	Primary Application	Ports, Connector, Maximum Distance, and Cable Type	PoE Support	Maximum Frame Size (jumbo frame) Support	Queues per Port (Tx = Transmit, Rx = Receive)*	Buffer Size per Port
WS-X6548-GE-TX	Premier wiring closet	48, RJ-45, 100m, Category 5 cable	Field upgradable to Cisco Prestandard	Up to 1518 bytes per frame	Tx-1p2q2t (per 8 ports)	1 MB per 8 ports

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Product Number	Primary Application	Ports, Connector, Maximum Distance, and Cable Type	PoE Support	Maximum Frame Size (jumbo frame) Support	Queues per Port (Tx = Transmit, Rx = Receive)*	Buffer Size per Port
			and IEEE 802.3af		Rx-1p2t (per port)	
WS-X6548-GE-45AF	Premier wiring closet	48, RJ-45, 100m, Category 5 cable	Yes (both IEEE 802.3af and Cisco Prestandard)	Up to 1518 bytes per frame	Tx-1p2q2t (per 8 ports) Rx-1p2t (per port)	1 MB per 8 ports
WS-X6548V-GE-TX	Premier wiring closet	48, RJ-45, 100m, Category 5 cable	Yes, only Cisco Prestandard	Up to 1518 bytes per frame	Tx-1p2q2t (per 8 ports) Rx-1p2t (per port)	1 MB per 8 ports
WS-X6516-GE-TX	Data center and server farm	16, RJ-45, 100m, Category 5 cable	No	Up to 9216 bytes per frame	Tx-1p2q2t Rx-1p1q4t	512 KB
WS-X6548-RJ-45	Server Farmfarm	48, RJ-45, 100m, Category 5 cable	No	Up to 1518 bytes per frame	Tx-1p3q1t Rx-1p1q	1.2 MB
WS-X6548-RJ-21	Server farm	48, RJ-21, 100m, Category 5 cable	No	Up to 1518 bytes per frame	Tx-1p3q1t Rx-1p1q	1.2 MB

* Queues legend: 1p3q1t = 1 priority queue, 3 round-robin queues, and 1 threshold

Figure 2. Cisco Express Forwarding 256 10100/1000 Interface Module (part number WS-X6548-GE-TX)

Figure 3. Cisco Express Forwarding 256 Copper 10/100 Interface Module (part number WS-X6548-RJ-45)

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Figure 4. Cisco Express Forwarding 256 Copper 10/100 Interface Module (part number WS-X6548-RJ-21)

CISCO CATALYST 6500 SERIES POE, CLASSIC 10/100, AND 10/100/1000 INTERFACE MODULES

Designed for deployment in wiring closets, high-density Cisco Catalyst 6500 Series Classic 10/100 and 10/100/1000 interface modules provide line-rate 10/100 Ethernet forwarding and gigabit bandwidth to the desktop capabilities. These interface modules feature PoE field-installable daughter cards for pay-as-you-grow investment protection and flexibility.

The 96 port 10/100 module (part number WS-X6196-21AF) is the industry's first 96-port 10/100 RJ-21 module with IEEE 802.3af support for all 96 ports, helping enable the Cisco Catalyst 6500 Series to deliver the industry's highest port densities ranging from 192 10/100 ports in a Cisco Catalyst 6503 chassis to 1152 10/100 ports in a Cisco Catalyst 6513 chassis for a very cost-effective solution in the wiring closet.

The WS-X6196-RJ-21 module doubles the port density in the system in the same footprint, using the stacked standard RJ-21 connectors. Port-density improvement can be achieved with no incremental investment in the cable infrastructure. With the 802.3af PoE daughter card, this module can support up to 96 Class 2 devices or 62 Class 3 devices per module (960W of PoE per module).

The 96-port 10/100 module (part number WS-X6148X2-RJ-45) is the industry's first 96-port 10/100 RJ-45 module that helps enable the Cisco Catalyst 6500 Series to deliver industry's highest port densities, ranging from 192 10/100 ports in a Cisco Catalyst 6503 chassis to 1152 10/100 ports in a Cisco Catalyst 6513 chassis for a very cost-effective solution in the wiring closet.

The 96-port 10/100 module (part number WS-X6148X2-RJ-45) doubles the port density in the system by allowing it to expand from 48 ports to 96 ports per slot with the addition of a splitter (included), typically mounted at the patch panel. The splitting also can occur at the wall jack, providing another option for doubling the port density of the switch without costly rewiring. This module also can function as a regular 48-port 10/100 module for maximum flexibility and scalability in the future. With the 802.3af PoE daughter card, this module can support up to 48 Class 3 devices per module when operating as a 48-port module, or up to 96 Class 2 devices per module when operating as a 96-port module (960W of PoE per module).

Using RJ-21 or RJ-45 connectors, the Cisco Catalyst 6500 Series classic 10/100 and 10/100/1000 modules are ready to be deployed in virtually all wiring-closet environments (Table 5) with the following operational advantages and characteristics:

- *Forwarding architecture*—These modules provide centralized Cisco Express Forwarding.
- *Forwarding performance*—These modules forward packets up to 15 Mpps per system.
- *Fabric connection*—These modules provide a 32-Gbps shared bus connection.
- *Supervisor engine*—These modules work with Supervisor Engine 1A, Supervisor Engine 2, Supervisor 32, or Supervisor Engine 720.
- *Distributed forwarding upgrade*—No upgrade is available; classic interface modules cannot be upgraded for distributed forwarding.
- *Slot requirements*—These modules can occupy any slot in any Cisco Catalyst 6500 Series chassis.
- *Maximum port density per chassis*—These modules support up to 1152 10/100 ports or 576 10/100/1000 ports in the Cisco Catalyst 6513 chassis; up to 768 10/100 ports or 384 10/100/1000 ports in the Cisco Catalyst 6509 chassis; up to 480 10/100 ports or 240 10/100/1000 ports in the Cisco Catalyst 6506 chassis; and up to 192 10/100 ports or 96 10/100/1000 ports in the small-form-factor Cisco Catalyst 6503 chassis.
- *Field-installable and -upgradable inline-power daughter cards*—These modules help enable centralized power distribution to IP phones, wireless access points, and other devices by sharing the same Category 5 UTP cabling used for network connections.

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Note: Some of these modules are designed to support field upgrades to the IEEE 802.3af PoE standard with a new daughter card, providing maximum investment protection. Table 6 for details.

- *TDR*—TDR is supported in all the 10/100/1000 modules and 10/100 modules (product numbers WS-X6148A-RJ-45 and WS-X6148A-45AF); TDR tests cabling by sending signals down the cable to identify faults in each twisted pair.

Table 5. Classic 10/100 and 10/100/1000 Modules

Product Number	Primary Application	Ports, Connector, Maximum Distance, and Cable Type	PoE Support	Maximum Frame Size (jumbo frame) Support	Queues per Port (Tx = Transmit, Rx = Receive)*	Buffer Size per Port
WS-X6148A-GE-TX	Wiring closet	48, RJ-45, 100m, Category 5 cable	Field-upgradable to Cisco Prestandard and IEEE 802.3af	Up to 9216 bytes per frame	Tx-1p3q8t Rx-1q2t	2.67 MB
WS-6148-GE-TX	Wiring closet	48, RJ-45, 100m, Category 5 cable	Field-upgradable to Cisco Pre standard and IEEE 802.3af	Up to 1518 bytes per frame	Tx-1p2q2t (per 8 ports) Rx-1p2t (per port)	1 MB per 8 ports
WS-X6148A-GE-45AF	Wiring closet	48, RJ-45, 100m, Category 5 cable	Yes (both IEEE 802.3af and Cisco Prestandard)	Up to 9216 bytes per frame	Tx-1p3q8t Rx-1q2t	2.67 MB
WS-X6148-GE-45AF	Wiring closet	48, RJ-45, 100m, Category 5 cable	Yes (Both both IEEE 802.3af and Cisco Prestandard)	Up to 1518 bytes per frame	Tx-1p2q2t (per 8 ports) Rx-1p2t (per port)	1 MB per 8 ports
WS-X6148V-GE-TX	Wiring closet	48, RJ-45, 100m, Category 5 cable	Yes, only Cisco Prestandard	Up to 1518 bytes per frame	Tx-1p2q2t (per 8 ports) Rx-1p2t (per port)	1 MB per 8 ports
WS-X6348-RJ45	Wiring closet	48, RJ-45, 100m, Category 5 cable	Field-upgradable to only Cisco Prestandard and not IEEE 802.3af	Up to 8092 bytes per frame	Tx-2q2t Rx-1q4t	128 KB
WS-X6348-RJ45V	Wiring closet	48, RJ-45, 100m, Category 5 cable	Yes, only Cisco Prestandard	Up to 8092 bytes per frame	Tx-2q2t Rx-1q4t	128 KB
WS-X6348-RJ21V	Wiring closet	48, RJ-21, 100m, Category 5 cable	Yes, only Cisco Prestandard	Up to 8092 bytes per frame	Tx-2q2t Rx-1q4t	128 KB
WS-X6196-RJ-21	Wiring closet	96, RJ-21, 100m, Category 5 cable	Field-upgradable to Cisco Prestandard and IEEE 802.3af	Up to 9216 bytes per frame	Tx-1p3q1t Rx-1p1q0t	1.2 MB

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Product Number	Primary Application	Ports, Connector, Maximum Distance, and Cable Type	PoE Support	Maximum Frame Size (jumbo frame) Support	Queues per Port (Tx = Transmit, Rx = Receive)*	Buffer Size per Port
WS-X6196-21AF	Wiring closet	96, RJ-21, 100m, Category 5 cable	Yes (both IEEE 802.3af and Cisco Prestandard)	Up to 9216 bytes per frame	Tx-1p3q1t Rx-1p1q0t	1.2 MB
WS-X6148X2-RJ-45	Wiring closet	48, scalable to 96, RJ-45, 100m, Category 5 cable	Field-upgradable to Cisco Prestandard and IEEE 802.3af	Up to 9216 bytes per frame	Tx-2q2t Rx-1q4t	1.2 MB
WS-X6148X2-45AF	Wiring closet	48, scalable to 96, RJ-45, 100m, Category 5 cable	Yes (both IEEE 802.3af and Cisco Prestandard)	Up to 9216 bytes per frame	Tx-2q2t Rx-1q4t	1.2 MB
WS-X6148A-RJ-45	Wiring closet	48, RJ-45, 100m, Category 5 cable	Field-upgradable to IEEE 802.3af	Up to 9216 bytes per frame	Tx-1p3q8t Rx-1p1q4t	1.2 MB
WS-X6148A-45AF	Wiring closet	48, RJ-45, 100m, Category 5 cable	Yes (both IEEE 802.3af and Cisco Prestandard)	Up to 9216 bytes per frame	Tx-1p3q8t Rx-1p1q4t	1.2 MB
WS-X6148-RJ45	Wiring closet	48, RJ-45, 100m, Category 5 cable	Field-upgradable to only Cisco Prestandard and Advance Replacement for IEEE 802.3af	Up to 8092 bytes per frame	Tx-2q2t Rx-1q4t	128 KB
WS-X6148-45AF	Wiring closet	48, RJ-45, 100m, Category 5 cable	Yes (both IEEE 802.3af and Cisco Prestandard)	Up to 8092 bytes per frame	Tx-2q2t Rx-1q4t	128 KB
WS-X6148-RJ45V	Wiring closet	48, RJ-45, 100m, Category 5 cable	Yes, only Cisco Prestandard	Up to 8092 bytes per frame	Tx-2q2t Rx-1q4t	128 KB
WS-X6148-RJ21	Wiring closet	48, RJ-21, 100m, Category 5 cable	Field-upgradable to only Cisco Prestandard and Advance Replacement for IEEE 802.3af	Up to 8092 bytes per frame	Tx-2q2t Rx-1q4t	128 KB

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Product Number	Primary Application	Ports, Connector, Maximum Distance, and Cable Type	PoE Support	Maximum Frame Size (jumbo frame) Support	Queues per Port (Tx = Transmit, Rx = Receive)*	Buffer Size per Port
WS-X6148-21AF	Wiring closet	48, RJ-21, 100m, Category 5 cable	Yes (both IEEE 802.3af and Cisco Prestandard)	Up to 8092 bytes per frame	Tx-2q2t Rx-1q4t	128 KB
WS-X6148-RJ21V	Wiring closet	48, RJ-21, 100m, Category 5 cable	Yes, only Cisco Prestandard	Up to 8092 bytes per frame	Tx-2q2t Rx-1q4t	128 KB

* Queues legend: 1p3q1t = 1 priority queue, 3 round-robin queues, and 1 threshold

Figure 5. Cisco Classic 48-Port 10/100/1000 Module (part number WS-X6148A-GE-TX) with 802.3af PoE Daughter (floating above) (part number WS-F6K-GE48-AF)

Figure 6. Cisco Classic 96-Port 10/100 802.3af PoE Module (part number WS-X6148X2-45AF)

Figure 7. Cisco Classic 48-Port 10/100 802.3af PoE Module (part number WS-X6148A-RJ-45)

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Figure 8. Cisco Classic 48-Port 10/100 802.3af PoE Module, RJ-21 (part number WS-X6148-21AF)

Figure 9. Cisco Classic 96-Port 10/100 (with field upgrade option to 802.3af PoE module) (part number WS-X6196-RJ-21)

CISCO CATALYST 6500 SERIES DATA-ONLY CLASSIC GIGABIT ETHERNET-OVER-COPPER INTERFACE MODULE

Designed for distribution and core layers and for data-center and Web-hosting applications, the Cisco Catalyst 6500 Series Classic 16-port Gigabit Ethernet interface modules provide line-rate Gigabit Ethernet forwarding with the following operational advantages:

- *Forwarding architecture*—These modules use centralized Cisco Express Forwarding.
- *Forwarding performance*—These modules forward packets up to 15 Mpps per system.
- *Fabric connection*—These modules provide a 32-Gbps shared bus connection.
- *Supervisor engine*—These modules work with Supervisor Engine 1A, Supervisor Engine 2, Supervisor 32, or Supervisor Engine 720.
- *Distributed forwarding upgrade*—No upgrade is available; classic interface modules cannot be upgraded for distributed forwarding.
- *Slot requirements*—There are no slot requirements; the modules can occupy any slot in any Cisco Catalyst 6500 Series chassis.
- *Maximum port density per chassis (16-port modules)*—These modules support up to 192 ports per Cisco Catalyst 6513 and up to 128 ports per Cisco Catalyst 6509.

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ORDERING INFORMATION

Table 6 provides part-number information for Cisco Catalyst 6500 Series 10/100 and 100/1000 Ethernet interface modules.

Table 6. Cisco Catalyst 6500 Series 10/100 and 10/100/1000 Ethernet Interface Modules

Product Number	Description
10/100/1000	
WS-X6748-GE-TX	Cisco Catalyst 6500 Series 48-Port 10/100/1000 RJ-45 Cisco Express Forwarding 720 Interface Module; field-upgradable to support distributed forwarding with the addition of the distributed forwarding daughter card (part number WS-F6700-DFC3A=)
WS-X6548-GE-TX	Cisco Catalyst 6500 Series 48-Port 10/100/1000 RJ-45 Cisco Express Forwarding 256 Interface Module; field-upgradable to support Cisco Prestandard PoE daughter card (part number WS-F6K-VPWR-GE=) or 802.3af PoE daughter card (part number WS-F6K-GE48-AF=)
WS-X6548-GE-45AF	Cisco Catalyst 6500 Series 48-Port 10/100/1000 RJ-45 Cisco Express Forwarding 256 Interface Module with 802.3af PoE daughter card (that is, includes daughter card [part number WS-F6K-GE48-AF=])
WS-X6548V-GE-TX	Cisco Catalyst 6500 Series 48-Port 10/100/1000 RJ-45 Cisco Express Forwarding 256 Interface Module with Cisco Prestandard PoE Daughter Card (that is, includes daughter card [part number WS-F6K-VPWR-GE=])
WS-X6516-GE-TX	Cisco Catalyst 6500 Series 16-Port 10/100/1000 RJ-45 Cisco Express Forwarding 256 Interface Module; field-upgradable to support distributed forwarding with the addition of the distributed forwarding daughter card (part number WS-F6K-DFC= or DFC3)
WS-X6148A-GE-TX	Cisco Catalyst 6500 Series 48-Port 10/100/1000 RJ-45 Classic Interface Module; field-upgradable to support 802.3af PoE daughter card (part number WS-F6K-GE48-AF=)
WS-X6148-GE-TX	Cisco Catalyst 6500 Series 48-Port 10/100/1000 RJ-45 Classic Interface Module; field-upgradable to support Cisco Prestandard PoE Daughter Card (part number WS-F6K-VPWR-GE=) or 802.3af PoE daughter card (part number WS-F6K-GE48-AF=)
WS-X6148A-GE-45AF	Cisco Catalyst 6500 Series 48-Port 10/100/1000 RJ-45 Classic Interface Module with 802.3af PoE daughter card (that is, includes daughter card (part number WS-F6K-GE48-AF=)
WS-X6148-GE-45AF	Cisco Catalyst 6500 Series 48-Port 10/100/1000 RJ-45 Classic Interface Module with 802.3af PoE daughter card (that is, includes daughter card (part number WS-F6K-GE48-AF=)
WS-X6148V-GE-TX	Cisco Catalyst 6500 Series 48-Port 10/100/1000 RJ-45 Classic Interface Module with Cisco Prestandard PoE Daughter Card (that is, includes daughter card (part number WS-F6K-VPWR-GE=)
10/100	
WS-X6548-RJ-45	Cisco Catalyst 6500 Series 48-Port Cisco Express Forwarding 256 10/100 RJ-45 Interface Module; field-upgradable to support distributed forwarding with the addition of the distributed forwarding daughter card (part number WS-F6K-DFC= or DFC3)

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Product Number	Description
WS-X6548-RJ-21	Cisco Catalyst 6500 Series 48-Port, Cisco Express Forwarding 256 10/100 RJ-21 Interface Module; field-upgradable to support distributed forwarding with the addition of the distributed forwarding daughter card (part number WS-F6K-DFC= or DFC3)
WS-X6348-RJ45	Cisco Catalyst 6500 Series 48-Port 10/100 RJ-45 Classic Interface Module; field-upgradable to support Cisco Prestandard PoE Daughter Card (part number WS-F6K-VPWR=)
WS-X6348-RJ45V	Cisco Catalyst 6500 Series 48-Port 10/100 RJ-45 Classic Interface Module with Cisco Prestandard PoE Daughter Card (that is, includes daughter card [part number WS-F6K-VPWR=])
WS-X6348-RJ21V	Cisco Catalyst 6500 Series 48-Port 10/100 RJ-21 Classic Interface Module with Cisco Prestandard PoE Daughter Card (that is, includes daughter card [part number WS-F6K-VPWR=])
WS-X6148X2-RJ-45	Cisco Catalyst 6500 Series 96-Port 10/100 RJ-45 Classic Interface Module; field-upgradable to support 802.3af PoE daughter card (part number WS-F6K-FE48X2-AF=)
WS-X6148X2-45AF	Cisco Catalyst 6500 Series 96-Port 10/100 RJ-45 Classic Interface Module with 802.3af PoE daughter card (that is, includes daughter card [part number WS-F6K-FE48X2-AF=])
WS-X6196-RJ-21	Cisco Catalyst 6500 Series 48-Port 10/100 RJ-21 Classic Interface Module; field-upgradable to support 802.3af PoE daughter card (part number WS-F6K-FE48X2-AF=)
WS-X6196-21AF	Cisco Catalyst 6500 Series 96-Port 10/100 RJ-21Classic Interface Module with 802.3af PoE daughter card (that is, includes daughter card [part number WS-F6K-FE48X2-AF=])
WS-X6148A-RJ-45	Cisco Catalyst 6500 Series 48-Port 10/100 RJ-45 Classic Interface Module; field-upgradable to support 802.3af PoE daughter card (part number WS-F6K-GE48-AF=)
WS-X6148-RJ-45	Cisco Catalyst 6500 Series 48-Port 10/100 RJ-45 Classic Interface Module; upgradable to support Cisco Prestandard PoE Daughter Card (part number WS-F6K-VPWR=) or to IEEE 802.3af PoE daughter card (part number WS-X6148-45AF-UG=)
WS-X6148A-45AF	Cisco Catalyst 6500 Series 48-Port 10/100 RJ-45 Classic Interface Module with IEEE 802.3af PoE daughter card
WS-X6148-45AF	Cisco Catalyst 6500 Series 48-Port 10/100 RJ-45 Classic Interface Module with IEEE 802.3af PoE daughter card
WS-X6148-RJ45V	Cisco Catalyst 6500 Series 48-Port 10/100 RJ-45 Classic Interface Module with Cisco Prestandard PoE Daughter Card (that is, includes daughter card [part number WS-F6K-VPWR=])
WS-X6148-RJ-21	Cisco Catalyst 6500 Series 48-Port 10/100 RJ-21 Classic Interface Module; upgradable to support Cisco Prestandard PoE Daughter Card (part number WS-F6K-VPWR=) or to IEEE 802.3af PoE daughter card (part number WS-X6148-21AF-UG=)
WS-X6148-21AF	Cisco Catalyst 6500 Series 48-Port 10/100 RJ-21 Classic Interface Module with IEEE 802.3af PoE daughter card
WS-X6148-RJ21V	Cisco Catalyst 6500 Series 48-Port 10/100 RJ-21 Classic Interface Module with Cisco Prestandard PoE Daughter Card (that is, includes daughter card [part number WS-F6K-VPWR=])

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Table 7. Cisco Catalyst 6500 Series Power Over Ethernet Daughter Cards

Part Number	Description
WS-F6K-GE48-AF=	Cisco Catalyst 6500 Series 802.3af PoE Daughter Card for 10/100/1000 modules (part numbers WS-X6148-GE-TX, WS-X6148V-GE-TX, WS-X6548-GE-TX, and WS-X6548V-GE-TX)
WS-F6K-FE48X2-AF=	Cisco Catalyst 6500 Series 802.3af PoE Daughter Card for WS-X6148X2-RJ-45) module
WS-X6148-45AF-UG=	Cisco Catalyst 6500 Series 802.3af PoE Advanced Upgrade for (part number WS-X6148-RJ45 or WS-X6148-RJ45V)
WS-X6148-21AF-UG=	Cisco Catalyst 6500 Series 802.3af PoE Advanced Upgrade for (part number WS-X6148-RJ21 or WS-X6148-RJ21V)
WS-F6K-VPWR=	Cisco Catalyst 6500 Series Cisco Prestandard PoE Daughter Card for 10/100 modules (for WS-X6148-RJxx and WS-X6348-xx)
WS-F6K-VPWR-GE=	Cisco Catalyst 6500 Series Cisco Prestandard PoE Daughter Card for 10/100/1000 modules (part numbers WS-X6148-GE-TX and WS-X6548-GE-TX)

ORDERING INFORMATION—DFC DAUGHTER CARDS

Table 8 provides part-number information for distributed forwarding daughter cards for the Cisco Catalyst 6500 Series Cisco Express Forwarding 256 and Cisco Express Forwarding 720 Ethernet interface modules.

Table 8. Cisco Catalyst 6500 Series 10/100 and 100/1000 Distributed Forwarding Cards

Part Number	Description
WS-F6K-DFC	Cisco Catalyst 6500 Series DFC3A for Cisco Catalyst 6500 Series; Cisco Catalyst 6816 modules used with Supervisor Engine 2
WS-F6K-DFC3A	Cisco Catalyst 6500 Series DFC3A for Cisco Catalyst 6500; Cisco Catalyst 6816 modules used with Supervisor Engine 720
WS-F6K-DFC3B	Cisco Catalyst 6500 Series DFC3B for Cisco Catalyst 6500; Cisco Catalyst 6816 modules used with Supervisor Engine 720
WS-F6K-DFC3BXL	Cisco Catalyst 6500 Series DFC3BXL for Cisco Catalyst 6500; Cisco Catalyst 6816 modules used with Supervisor Engine 720
MEM-DFC-256MB	256 MB DRAM option for DFC
MEM-DFC-512MB	512 MB DRAM option for DFC
WS-F6700-DFC3A	Cisco Catalyst 6500 Series DFC3A for Cisco Catalyst 6700 Series modules
WS-F6700-DFC3B	Cisco Catalyst 6500 Series DFC3B for Cisco Catalyst 6700 Series modules
WS-F6700-DFC3BXL	Cisco Catalyst 6500 Series DFC3BXL for Cisco Catalyst 6700 Series modules

SPECIFICATIONS

Standard Network Protocols

- Ethernet: IEEE 802.3 and 10BASE-T

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- Fast Ethernet: IEEE 802.3, 100BASE-TX, and 100BASE-FX
- Gigabit Ethernet: 1000BASE-TX
- IEEE 802.1d, IEEE 802.1p, IEEE 802.1q, IEEE 802.1s, IEEE 802.1w, IEEE 802.3x, IEEE 802.3z, IEEE 802.3ab, IEEE 802.3ad, and IEEE 802.3af

Physical Specification

- Occupies one slot in a Cisco Catalyst 6500 Series chassis
- Dimensions (H x W x D): 1.2 x 14.4 x 16 in. (3.0 x 35.6 x 40.6 cm)

Environmental Conditions

- Operating temperature: 32 to 104°F (0 to 40°C)
- Storage temperature: –40 to 167°F (–40 to 75°C)
- Relative humidity: 10 to 90 percent, noncondensing
- Operating altitude: –197 to 9843 ft (–60 to 3000m)

Safety Compliance

- UL 1950
- CSA-C22.2 No. 950
- EN 60950
- IEC 950
- AS/NZS 3260
- IEC 825
- EN 60825
- 21CFR1040

EMC Compliance

- FCC Part 15 (CFR 47) Class A
- VCCI Class A with UTP, Class B with STP
- EN55022 Class A with UTP, Class B with STP
- CISPR 22 Class A with UTP, Class B with STP
- CE marking
- AS/NZS 3548 Class A with UTP, Class B with STP

Network Management

- ETHERLIKE-MIB (RFC 1643)
- IF-MIB (RFC 1573)
- Bridge MIB (RFC 1493)
- CISCO-STACK-MIB
- CISCO-VTP-MIB
- CISCO-CDP-MIB
- RMON MIB (RFC 1757)
- CISCO-PAGP-MIB
- CISCO-STP-Extensions-MIB
- CISCO-VLAN-Bridge-MIB
- CISCO-VLAN-Membership-MIB
- CISCO-UDLDP-MIB

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- CISCO-ENTITY-FRU-CONTROL-MIB
- CISCO-COPS-CLIENT-MIB
- ENTITY-MIB (RFC 2037)
- HC-RMON
- RFC1213-MIB (MIB-II)
- SMON-MIB

Inline-Power Specifications

- IEEE 802-3af – Output power per port: Typically 54V up to 350 mA
- Cisco Prestandard – Output power per port: Typically 42V up to 166 mA
- Pin assignment: 1, 2, 3, and 6

Maximum Station-to-Station Cabling Distance

- 10/100BASE-TX, 100BASE-TX Fast Ethernet, and 10, 100, and 1000 Mbps: Category 5, 5e, and 6 UTP: 328 ft (100m), 100-ohm STP: 328 ft (100m); half or full duplex
- Maximum power: Off (maximum power condition not reached); on (maximum power condition reached; no more phones will receive inline power from this module)

Indicators and Interfaces

- Status: Green (operational); red (faulty); orange (module booting or running diagnostics)
- Link good: Green (port active); orange (disabled); off (not active or not connected); blinking orange (failed diagnostic and disabled)
- 10, 100, and 1000 Mbps: RJ-45 (female)
- 10/100BASE-TX and 100BASE-TX: RJ-45 (female)

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FOR MORE INFORMATION

For more information about the Cisco Catalyst 6500 Series Switch, contact your local account representative or visit:

http://www.cisco.com/en/US/products/hw/switches/ps708/index.html

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